

Ocean Data Management at NCDC

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Project Summary

The project “Ocean Data Management at NCDC” directly supports the mission of NCDC (NOAA National Climatic Data Center): “To provide stewardship and access to the Nation’s resource of global climate and weather related data and information, and assess and monitor climate variation and change.” This in turn directly supports the NOAA Mission: “To understand and predict changes in Earth’s environment and conserve and manage coastal and marine resources to meet our Nation’s economic, social, and environmental needs.”

NCDC plays an active and important role in the national and international climate change monitoring and assessment programs [e.g., the US Climate Change Science Program (CCSP) Syntheses]. Climate change monitoring and assessment require meteorological and marine data over both land and ocean. Changes of environmental variables at and near the marine surface are important since they occur over approximately 70% of the Earth’s surface and contain important climate change signals. Due to the drastic property differences between water and air (e.g., density and heat capacity), huge amount of water, energy, momentum and gases (e.g., carbon dioxide) are constantly exchanged at the turbulent air-sea interface. These exchanges regulate the weather in the short term and the climate change in the long term. Thus, NCDC has been actively archiving, serving and utilizing the world’s surface marine data, and it will need to continue to do so.

Modern day Global Ocean Observing System (GOOS) consists of multiple platforms and instruments (both in-situ and remote sensing). Each of these observations contributes to the understanding and assessment of climate change signals. However, individual instrument observations have limitations in coverage (in both time and space) and limitations on accuracy. To maximize benefits and integrally use all the available observations, it is necessary to blend them together to produce higher resolution and higher accuracy products. For example, research on global water and energy budgets and numerical weather and ocean forecasts demand increasingly higher resolution forcing data (better than daily and 50 km; e.g., WMO/TD-No. 1036, 2000; Curry et al. 2004). The recent international Global Earth Observation System of Systems (GEOSS) and Global Climate Observing System (GCOS) also called for optimal combinations of the above platforms for integrated global observing system and service.

There are typically three types of errors in observations and blended products: 1) random error; 2) sampling error; and 3) bias error. The bias error is the systematic difference between one instrument (or a set of instruments, e.g., in-situ observations) and another (e.g., remote sensing/satellite observations). The combined error for all terms should be reduced to a required accuracy for meaningful climate change diagnostics. In the satellite era, satellite observations provide dense data coverage, thus in-situ data play a minor role in the reduction of random and sampling errors and in increasing resolutions in blended products. However, in-situ observations provide the “ground-truth”, thus play an essential role in correcting the systematic biases of indirect measurements (e.g., remote sensing/satellite observations that are calibrated to in-situ observations).

The overall objectives of this project are: 1) to ingest the world's marine observations into the NCDC archives; 2) to quality control the data for various applications (such as for Reanalysis); 3) to produce blended products for optimal use of all the observations; and 4) to improve services for a wide variety of user communities. The highlighted accomplishments for the past fiscal year are described in the next section.

Accomplishments

1. ICOADS - Increased data volume of archive and service; online data for years prior to 2005; GIS capabilities.

NCDC continued to ingest, archive, quality control and serve the ICOADS data. The two key priorities for expanding data access capabilities have been: 1) making data prior to 2005 available online (via Climate Data Online—CDO) for selected data sources after additional quality controls; and 2) developing a prototype GIS map services linked to the CDO interface. Both of the objectives have been completed. Customers are now able to retrieve data from 1994-2005 for several data sources and all data sources from 2005 to present. ICOADS are available online. This replaces the off-line ordering and delivery of data as done in the past. The GIS map service will be available before the end of the calendar year. This provides a GIS-based map interface for users to locate and access marine data, and to overlay various features/layers which are available through GIS Services (<http://www7.ncdc.noaa.gov/CDO/CDOMarineSelect.jsp>).

2. VOSClm - Increased data volume of archive and service; improved VOSClm webpage

VOSClm is an ongoing project within WMO/IOC JCOMM's Voluntary Observing Ships' Scheme, to which NOAA is a major partner. As the VOSClm Data Assembly Center, NCDC continued to ingest, archive, quality control and serve the ICOADS data. Additionally, we improved the VOSClm website. Requested by the "Ship Observations Team III Meeting", NCDC undertook a revised design of the official VOSClm website. Elements of redesign included: a) a simpler, more aesthetically-pleasing suite of pages; b) a design that is more conducive to easy navigation with tabs indicating the main elements of the page; and c) an accessible data link, providing ASCII text files for scientific use. The redesigned page (Fig. 1) was developed in consultation with the VOSClm partners and is made available for comment and revision.

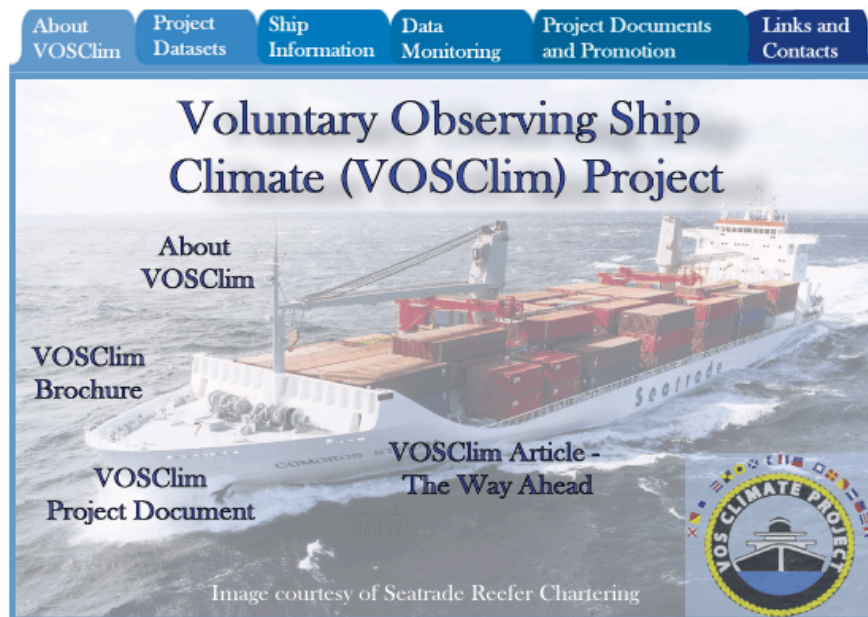


Figure 1. VOSClim webpage with links to access ship information and project datasets:
<http://www.ncdc.noaa.gov/oa/climate/vosclim/vosclim.html>

ASCII data access is considered of more utility for the current level of scientific and general users and therefore is a critical addition. Drop down menus for access to monthly data monitoring statistics are provided as well as links to ship photographs and other metadata information. There are currently 247 active VOSClim ships, which in 2007 surpassed the project target of 200 participating vessels.

3. Re-processed blended high resolution sea wind speed - Version 1.1

Blended high resolution sea surface winds from all long-term US sea wind speed observing satellites were produced. Global 0.25° winds are available with time resolutions of 6-hourly, daily, and monthly. Data are available at several interactive data servers (see links at <http://www.ncdc.noaa.gov/oa/rsad/blendedseawinds.html>).

For long-term climate analysis and adherence to the principles of the long-term Climate Data Records (CRD) and the Ten Climate Monitoring Principles, reprocessing of the blended product for the whole time period (July 1987 onward) was completed. Major improvements in the satellite retrievals (input to the blended products) include: 1) Removal of spurious trends in the wind speed; 2) Implementation of a much-improved rain rate algorithm; 3) Achievement of better consistency for all retrievals over the 8 satellite platforms (i.e, 6 SSM/I, TMI, and AMSR-E); and 4) Minor improvements in other retrievals, namely SST and water vapor.

4. Development and production of vector sea winds and wind stress – Version 1.2

For the computation of turbulent air-sea fluxes of scalars (e.g., latent and sensible heat, fresh water by evaporation, carbon dioxide, etc), only sea surface wind speed is needed. However, for many other applications requested by users, vector winds and wind stresses are needed. Thus, we added directions to our blended wind speed products and compute the wind stresses. The wind directions were interpolated from the NOAA NCEP Reanalysis-2 output.

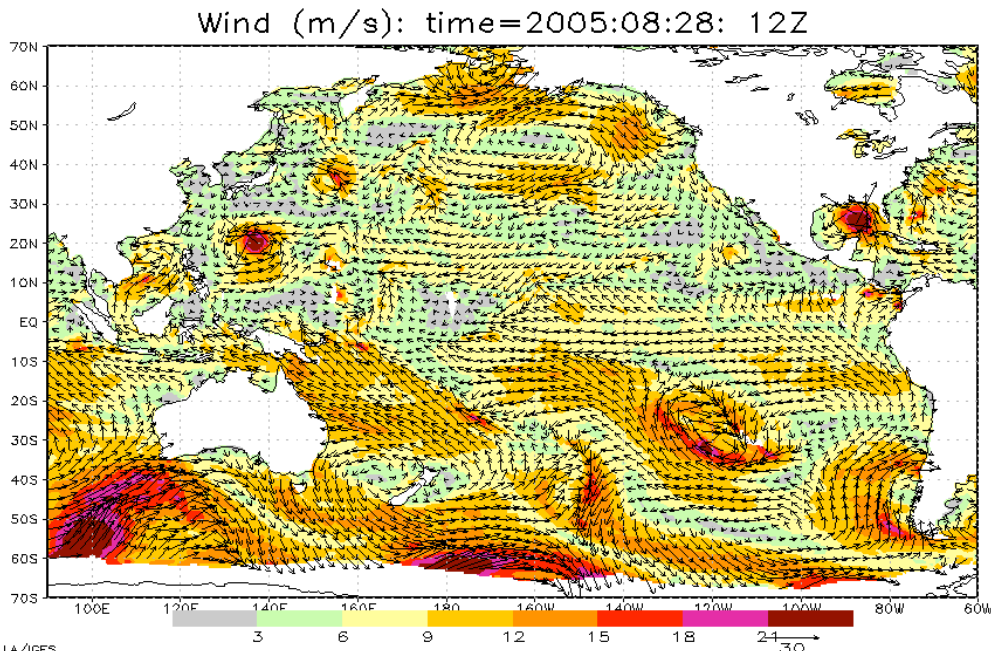


Figure 2. Example of the blended global 0.25° 6-hourly sea winds that show simultaneous Typhoon Talim and Hurricane Katrina. Vectors are sub-sampled for viewing clarity.

5. Development of blended sea winds using OI

In the blended wind speed, so far we employed a simple objective analysis scheme that weighs the observations by “distances” in both space and time to reduce alias effects when/where there are enough data. In this scheme, the error statistics in all observations are treated the same. However, in reality, observations may have different error statistics due to, for example, observations by different instruments (e.g., microwave versus radiometer) and in different atmospheric regimes (e.g., contamination in precipitation areas). Thus the blended winds will be improved by also weighting the observations by the more realistic error statistics, using the so-called objective analysis or optimum interpolation (OA/OI). In FY07, we have implemented Reynolds SST OI codes to sea winds, and some preliminary sea wind error statistics have been computed.

6. Development of a prototype interactive data server

The objective of this task is to establish an interactive web interface so that data from different sources (in-situ observations, satellite observations, numerical model results, and blended products) can be displayed and inter-compared in various ways. A prototype interactive web data server has been built.

Publications and Reports

Zhang, H.-M., G. Rutledge, R.W. Reynolds, F. Schwing and R. Mendelssohn, 2007: An Interoperable Marine Environmental Data and Web Service Across NOAA Line Offices. *PRIDE Investigators Meeting and Pacific Region Data Integration and Visualization Workshop*, 16 – 18 October 2007, Honolulu, HI.

- Zhang, H.-M., J.J. Bates, and R.W. Reynolds, 2006: Assessment of composite global sampling: sea surface wind speed. *Geophysical Research Letters*, **33**, L17714, doi:10.1029/2006GL027086, Vol. 33 (17).
- Xu, M., C.-P. Chang, C. Fu, Y. Qi, A. Robock, D. Robinson, and H.-M. Zhang, 2006: Steady decline of east Asian monsoon winds, 1969 - 2000: evidence from direct ground measurements of wind speed. *Journal of Geophysical Research –Atmospheres*, **111**, D24111, doi:10.1029/2006JD007337
- Sections in “*2007 NCDC PRODUCTS AND SERVICES GUIDE*” & NCDC & NESDIS Annual Reports.